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Large Hadron Collider
Magnet Division Procedure

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Title: 10M Long 8cm Dipole Coil Winding on NGC Winding Machine

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REVISION RECORD

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1. Scope:
This procedure describes the steps necessary to wind an 8cm dipole coil. The coil is assembled during winding from insulated Superconducting cable, copper wedges, wedge tips, end spacers and end saddles.

2. Applicable Documents:

| | |
|---|---|
| SMD OPM 8.1.1.37 | Operation of NGC Long Coil Winder |
| RHIC-MAG-Q-1004 | Discrepancy Reporting Procedure |
| RHIC-MAG-R-7337 | Kapton Coil Insulation Damage |
| 14010130 | 8cm Dipole Coil Winding and Curing Assembly |
| 25-1740.01-4 | Coil Scratch Protector |

3. Requirements:
The coil shall be wound in accordance with the Coil Drawing and Parts Kit List for the applicable magnet part number and manufacturing procedure described in paragraph 4 below.

3.1 Materials:

The following process materials are referenced for use in this procedure and shall be controlled for procurement, use, storage and handling by the documents or catalog descriptions listed below. Substitutions require prior approval by cognizant engineer.

| Reference Designation | Technical Designation | Source/Control |
|---|---|---|
| Degreasers | LPS Contact Cleaner | BNL Stock No. I-78279 |
| Zepspree | BNL Stock No. I-82792 | |
| Towel | Paper towel | BNL Stock No. I-83312 |
| Tack Rag | Gerson Tack Cloth | Gerson Co., Inc. Middleboro, MA |
| Frekote 700 | Frekote 700 Release Interface | Frekote Products Bulletin 700 |

| | | |
|---|---|---|
| Kapton | Kapton Tape<br>1.00 in.-wide<br>0.001 in.-thick with<br>0.0015 in.<br>Silicone Adhesive | R.H. Carlson<br>P.O. Box 1687<br>Greenwich, CT |
| Kapton | Kapton Tape<br>.75 in.-wide<br>0.0005 in.-thick with<br>0.0005 in. Silicone<br>Adhesive | R.H. Carlson<br>P.O. Box 1687<br>Greenwich, CT |
| Kapton | Kapton Tape<br>.50 in.-wide<br>0.0005 in.-thick with<br>0.0005 in. Silicone<br>Adhesive | R.H. Carlson<br>P.O. Box 1687<br>Greenwich, CT |
| Mylar | Mylar Type S<br>Plastic Film<br>(.005 in.-thick) | BNL Stock No. G-06710 |
| | Mylar Type A<br>Plastic Film<br>(.014 in.-thick) | BNL Stock No. G-06708 |
| Teflon<br>200 PH | Teflon PFA Film<br>(.002 in.-thick) | E.I. DuPont Co., Inc.<br>Fabricated Products<br>Dept. |
| Velcro Strap | Velcro Strap 24x5/8 | Gleicher Manufacturing<br>851 Jerusalem Rd.<br>Scotch Plains, NJ |
| Teflon Coated<br>Fiberglass Tape | Chemfluor TFE<br>Teflon Coated<br>Fiberglass Tape<br>(.003 in.-thick<br>Film with .003 in.-<br>thick adhesive) | Norton Chem Plast<br>Chemfluor Tapes<br>Product Bulletin B-8 |
| Teflon Tape | Teflon Tape<br>HM-350<br>.002 in.-thick with | E.I. DuPont Co., Inc.<br>Fabricated Products<br>Dept. |

| | | |
|---|---|---|
| | .0015 in.-thick silicone adhesive | |
| Scouring Pad | Cleaning Pad Fine “Scotch-Brite” | BNL Stock No. I-82360 |
| Cotton Swabs | Wood Applicator, Q-Tip | BNL Stock No. H-27668 |
| Clamping Ties | | BNL Stock No. A-59826 |
| Hose Clamps | Size 104mm x 105 to 178mm | Aero Seal |
| Neoprene Gloves | Gloves | BNL Stock Nos. K-62460 K-62500, K-62520, K-62540 or equivalent |
| Solder | Silvabrite Solder 4% Silver (Ag) 96% Tin (Sn) | Engelhard Corp. Route 152 Planville, MA |

Tools Required During Coil Winding

| | |
|---|---|
| Scissors | Delrin tapping tool |
| Metal shears | Scale (in.) |
| Degausser | Torque wrench |
| 5/16" + 3/8" nut drivers | 0.015" feeler gauge |
| Razor blades | House vacuum |
| Rawhide Mallets | Overhead crane |
| Micrometer | Hex key wrenches |
| Gaussmeter | |
| Heat Gun | |
| Bent tip needle nose pliers | |

3.2 Safety Precautions

3.2.1 All operators/winders shall be qualified by the cognizant technical supervisor in the safe operation of the coil winder, SMD OPM-8.1.1.37, Operation of NGC Long Coil Winder.

3.2.2 All lifting and handling operations requiring overhead crane operations shall be performed by personnel who are holders of valid Safety Awareness Certificates and who have been trained and certified for the lifting device being used by the Cognizant Engineer or Technical Supervisor.

3.2.3 Hard hats are required during crane operations.

3.2.4 Safety glasses shall be worn when tension is applied to cable.

3.2.5 Gloves and safety glasses shall be worn while using degreasers.

3.2.6 Caution must be taken in the proper disposal of degreaser, pads, swabs and towels.

3.2.7 Specific steps of this procedure contain electrical and mechanical assembly operations that impact the environment. Prior to performing these steps, personnel shall complete the applicable facility specific environmental training.

3.2.8 The mandrel assembly has an internal volume of oil used for curing. If leakage is detected from the mandrel quick disconnects (located on its end), the oil shall be cleaned up immediately and disposed of as regulated industrial waste.

3.3 Procedure:

3.3.1 Mandrel /Centerpost / Blade Cleaning

3.3.1.1 With the mandrel in the prep station, remove all tapes from mandrel, centerpost and blade sections remaining from previous coil cure.

3.3.1.2 Inspect mandrel, centerpost sections, blades assembly, and all tooling hardware for magnetization using gaussmeter. Demagnetize any tooling which reads greater than 10 gauss using the degausser.

**CAUTION**

**Gloves and safety glasses shall be worn while using degreasers. Failure to observe this caution may result in skin and/or eye irritation.**

3.3.1.3 Clean mandrel, centerpost and blade sections using scouring pads and degreaser to remove all foreign matter from surfaces to contact coil. Vacuum entire mandrel including thru-hole and threaded hole locations. Use cotton swab and degreaser to clean holes.

3.3.1.4 Inspect mandrel, centerpost and blade section surfaces to contact coil for burrs or scratches. Deburr if necessary using vacuum to remove chips.

3.3.1.5 Wipe mandrel, centerpost and blade surfaces clean using degreaser and towel. Follow up with a clean tack rag.

3.3.1.6 Apply one coat of Frekote 700 to the centerposts and pusher blades.

3.3.1.7 Apply Teflon tape HM-350 to the thin edge of pusher blades and to the centerpost straight section on both sides. Trim excess Teflon tape.

3.3.1.8 Install centerpost on mandrel. Install straight section locating pins flush or up to .06 in. below centerpost top surface. Torque centerpost mounting bolts to 36 in/lbs.

3.3.1.9 Apply Kapton tape (.75 X .0005 thick w/ .0005 adhesive) to the top of the centerpost covering all holes along the entire length.

3.3.1.10 Vacuum the mandrel surface opposite the centerpost.

3.3.1.11 Apply Teflon coated fiberglass tape 1.375 in.-wide x .003 in.-thick with .003 in. adhesive to the mandrel surface opposite the centerpost to cover all holes along the entire length. Attach mandrel rotating supports to the mandrel on the side opposite the centerpost.

3.3.2 Winding Mandrel Preparation and Transfer

3.3.2.1 Apply one coat of Frekote 700 to the entire winding mandrel, and to the centerpost and blades.

3.3.2.2 Place coil end scratch protectors on lead and non-lead ends of the winding mandrel.

3.3.2.3 Place a Mylar scratch protector (.014 in.-thick) over each mandrel end to cover thru holes. Tape to mandrel using Kapton adhesive tape (1.00 in. wide x .001 in. thick with .0015 in.-thick adhesive).

3.3.2.4 Apply one coat of FREKOTE 700 to the scratch protectors.

**CAUTION**

**Gloves and safety glasses shall be worn while using degreasers. Failure to observe this caution may result in skin and/or eye irritation.**

3.3.2.5 Attach bat wings (12010036-MCA) to the centerpost and blade spacer (do not install #7). Rotate the winding mandrel 180 degrees positioning the centerpost facing down.

3.3.2.6 Vacuum the winding machine top surface, spool carriage and strongback. Wipe these surfaces clean using degreaser and towel.

**WARNING**

**Hard hats are required when crane is in use. Failure to observe this caution may result in severe injury.**

3.3.2.7 Vacuum cable guides, clamps and end retainer tooling. Wipe clean with degreaser and towel. Follow up with a clean tack rag.

3.3.2.8 Lift mandrel and remove lower rollover details (3 large rings). Install #7 bat wing.

3.3.2.9 Transfer to winder and attach anti-rotation block on bat wing #2 and #7.

3.3.2.10 Line up bat wings with center of rollers on winding machine.

**CAUTION**

**Failure to properly secure bat wings #2 and #7 with anti-rotation blocks and pins could result in the mandrel falling off its supports.**

3.3.2.11 Insert an alignment pin in anti-rotation blocks and roller stanchions at bat wing #2 and #7.

3.3.2.12 Unfasten strongback/hoist from spacer block and remove with crane.

3.3.2.13 Remove 3/8” shims from spacer block.

3.3.2.14 Start up and set computer for manual control of winding machine as described in SMD OPM 8.1.1.37.

3.3.2.15 Position the trunnions to accept the strongback.

3.3.2.16 Load winder strongback onto spacer block and secure.

3.3.2.17 Pin rollover arms to bat wings and fasten trunnions to strongback.

3.3.2.18 Remove anti-rotation blocks and pins from bat wings #2 and #7.

3.3.2.19 Engage mandrel limit switch and rotate mandrel until centerpost is facing up.

3.3.2.20 Remove pins from rollover arms and remove bat wings.

3.3.2.21 Mount straight section cable clamps (12010039-SCL2) to centerpost.

3.3.2.22 Prepare coil end retainers, (1) apply 1 layer of Teflon-coated fiberglass tape (.003 in.-thick with .003 in. adhesive) to the surfaces that face the coil and trim to fit. (2) Cut 2 strips of Mylar (.005 in. thick) to a size of 8 in. long x 1 in. wide.

3.3.2.23 Mount the end coil end retainers and the Mylar strips to the centerpost. Fold overhanging portion of Mylar strip over the top of the coil end retainers and secure with Kapton adhesive tape (1.00 in.-wide x .001 in.-thick with .0015 in. adhesive - 12010181-20).

**NOTE**

**Reposition the Mylar strip when adding coil end retainer extensions during the winding.**

3.3.2.24 Inspect the coil parts kits, verify all parts are present and properly prepared. Check the parts kit drawing numbers and revision levels with the coil assembly drawing and parts list. If discrepancies are found, contact coil parts kitting technical supervisor or cognizant engineer.

3.3.3 Cable Preparation

3.3.3.1 Record serial number of insulated superconductor cable to be used on traveler. Verify that total footage of cable remaining on spool is at least 2050 feet as per the cable history segment card before starting to wind coil. This amount includes 19 feet for holding tension and 5 feet for length counter deviation.

3.3.3.2 Record the serial no. of the coil to be wound and the cable segment number on the traveler.

3.3.3.3 Complete cable history segment card on spool for coil. Subtract 2026 foot length of cable for one coil. See Fig. 1 for cable history segment card recording procedure. Attach copy of cable history segment card to coil winding traveler.

3.3.3.4 Record the coil start footage and coil end footage (relative to hub end) on the traveler.

3.3.3.5 Calibrate the mandrel and carriage encoders, then execute winding program “RHIC 1” as described in SMD OPM 8.1.1.37, "Operation of NGC Long Coil Winder".

**NOTE 1**

**Work instructions will automatically be printed on the overhead display. When a task is completed the enter key or start button must be pressed to proceed.**

**NOTE 2**

**The program can be stopped at any time by pressing “AUTO STOP” on the Position Controller Panel or “STOP” on the remote control.**

**NOTE 3**

**If the winder will be left unattended while in automatic mode, the main brake must be engaged.**

3.3.3.6 Start the automatic winder by pressing “START” on the remote control.

3.3.3.7 Confirm ready to start by pressing “START” again, the carriage will move to the winding start position.

3.3.3.8 Engage the carriage/spool brake and press “START”.

3.3.3.9 Using a micrometer, determine and mark the thick side of the cable; load the cable spool on the winding carriage with the thick side of the cable facing up.

3.3.3.10 Using two technicians, manually un-spool approximately 20 feet of cable.

3.3.3.11 Secure cable on spool with Kapton tape.

3.3.3.12 Thread cable through the guide pulleys and secure in carriage clamp, see figure 2.

3.3.3.13 Apply a bead of solder to the end of the cable. Remove Kapton insulation from the end of the cable, trimming to match the lead slot in the centerpost. Fasten trimmed ends of insulation with Kapton adhesive tape .50 in.-wide x .0005 in.-thick with .0005 in. adhesive - 12010181-02

**NOTE 1**

**Ensure unused solder is recycled or disposed of properly**

**NOTE 2**

**The cable insulation, made up of 2 layers of Kapton wrap, is removed after the cable end is soldered. This is to prevent the fraying of the cable during handling, which could possibly occur if the insulation were removed first.**

3.3.3.14 Thoroughly clean the cable with degreaser and paper towel.

3.3.3.15 Remove Kapton insulation from the cable in the centerpost end region at the lead end using the following procedure:

3.3.3.15.1 Mark the cable at the start of the straight section (26-11/16 from end of cable). Measure 2.25" in the winding direction and mark the cable.

3.3.3.15.2 Wrap 1 layer of Kapton adhesive tape 12010181-02 over each mark.

3.3.3.15.3 Carefully remove the Kapton wrap between the marks. Do not cut into the cable.

3.3.3.15.4 Apply a layer of .003 thick nomex to the side of the cable between turns 1 & 2. Trim to fit, no overlaps. The side of the cable against the centerpost is left bare.

3.3.3.16 Apply a coat of Frekote 700 to the end of the cable. The coated area will start where the cable will leave the slot, extending around the lead end of the centerpost and 15±.25 in. into the straight section of the first turn.

3.3.3.17 Attach cable to centerpost by placing the end of the cable into the centerpost slot. Check that the cable is mounted with the thick edge up.

3.3.3.18 Manually work the cable slack to the side of the carriage with the tension controls and hold by hand.

3.3.3.19 Slowly turn tension adjustment knob clockwise until the spindle drive motor is turned "on".

**WARNING**

**Safety glasses are required when tension is applied to cable. Failure to observe this caution may result in eye injury.**

**CAUTION**

**Pinch hazard. Be sure to keep hands clear of guide pulleys.**

3.3.3.20 Hold the cable to remove the slack, release the "MAIN BRAKE" and set tension adjustment knob at 100mA/20 lbs. Allow the slack to be taken up.

3.3.3.21 Press "START" and set the tension to 20±3 lbs.

3.3.3.22 Turn lump detector on winding carriage to ON position and set with a .015 in. feeler gauge.

3.3.3.23 Mount cable guide/clamps to the centerpost and clamp cable.

3.3.4 Winding Of Turns #1 Thru #4

**NOTE 1**

**Turn numbering designation is for coil winding purposes only. Turn number will be displayed on the control panel.**

**NOTE 2**

**The automatic controls on the coil winder will automatically stop the winding carriage at each coil end. At this point the overhead display panel will display part name and number to be installed at this location. After**

**installing specified part the start button shall be activated. The winding carriage will proceed to opposite coil end for process to be repeated.**

3.3.4.1 Start coil winding by pressing "START" button on remote control.

3.3.4.2 Confirm ready to start by pressing "START" again.

3.3.4.3 Bring the first turn of the insulated Superconducting cable around lead end of the centerpost and lightly tap into place using rawhide mallet and delrin tapping tool so it lies firmly against the centerpost and mandrel.

3.3.4.4 Complete winding of Turn #1 by bringing the cable around the non-lead end and continuing back to the lead end.

**NOTE**

**To hold cable and parts in place during winding, adjust clamps and resecure cable at each clamp location.**

3.3.4.5 Set the cable tension to 40±3lb.

3.3.4.6 Wind Turn #2 around the lead end and along the straight section to the non-lead end.

3.3.4.7 Insert Solid End Spacer #2 at the non-lead end.

3.3.4.8 Wind Turn #2 around the non-lead end and along the straight section to the lead end.

3.3.4.9 Insert Solid End Spacer #1 at the lead end.

3.3.4.10 Wind Turn #3 around the lead end and along the straight section to the non-lead end.

3.3.4.11 Insert Solid End Spacer #4 at the non-lead end.

3.3.4.12 Wind Turn #3 around the non-lead end and along the straight section to the lead end.

3.3.4.13 Insert Solid End Spacer #3 at the lead end.

3.3.4.14 Wind Turn #4 around the lead end and along the straight section to the non-lead end.

3.3.4.15 Install spacer guides at both ends with .030 thick nomex to hold down the first four turns.

3.3.4.16 Insert Solid End Spacer #5 at the non-lead end.

3.3.4.17 Wind Turn #4 around the non-lead end and along the straight section to the lead end.

3.3.5 Insert Wedge #1 And Wind Turn #5

3.3.5.1 Starting at the lead end of the coil, install Wedge-Wedge Tip Assembly 1A, insulated Wedges No. 1 and Wedge-Wedge Tip Assembly 1B. Install end spacer lamination at the lead end.

**NOTE 1**

**The wedges must be placed into the coil so that the markings are placed on the outer radius surface.**

**NOTE 2**

**Wedge-wedge tip interfaces are to be aligned relative to the centerpost straight section as per the coil winding and curing drawing and such that the gap between wedges does not exceed .064.**

**NOTE 3**

**Wedge tips are positioned under Laminated Assembly End Spacers.**

3.3.5.2 Wind Turn #5 around the lead end and along the straight section to the non-lead end.

3.3.5.3 Install Wedge-Wedge Tip Assembly 1C, Insulated Wedges No. 1 and Wedge-Wedge Tip Assembly 1D in proper orientation starting at the non-lead end.

3.3.5.4 Install End Spacer Lamination at the non-lead end, centered on coil axis

3.3.5.5 Wind Turn #5 around the non-lead end and along the straight section to the lead end.

3.3.5.6 Install End Spacer Lamination at the lead end, centered on coil axis.

3.3.6 Wind Turns #6 Thru #12

3.3.6.1 Wind Turn #6 around lead end and along straight section to the non-lead end.

3.3.6.2 Install Solid End Spacer #7 at the non-lead end.

3.3.6.3 Wind Turn #6 around the non-lead end and along the straight section to the lead end.

3.3.6.4 Insert Solid End Spacer #6 at the lead end.

3.3.6.5 Wind Turn #7 around the lead end and along the straight section to the non-lead end.

3.3.6.6 Insert Solid End Spacer #9 at the non-lead end.

3.3.6.7 Wind Turn #7 around non-lead end and along straight section to the lead end.

3.3.6.8 Insert Solid End Spacer #8 at the lead end.

3.3.6.9 Wind Turn #8 around the lead end and along the straight section to the non-lead end.

3.3.6.10 Insert End Spacer Lamination at the non-lead end, centered on coil axis.

3.3.6.11 Wind Turn #8 around the non-lead end and along the straight section to the lead end.

3.3.6.12 Wind Turns #9 thru #12, inserting end spacer laminations between individual turns at both ends (4 at LE, 4 at NLE).

3.3.6.13 Replace the short cable guide/clamps at the lead and non-lead ends with full length guide/clamps.

3.3.7 Insert Wedge #2 And Wind Turn #13

3.3.7.1 Starting at the lead end of the coil, install Wedge-Wedge Tip Assembly 2A, insulated Wedges No. 2 and Wedge-Wedge Tip Assembly 2B. Install end spacer lamination at the lead end.

**NOTE 1**

**The wedges must be placed into the coil so that the markings are placed on the outer radius surface.**

**NOTE 2**

**Wedge-Wedge Tip interfaces are to be aligned relative to the centerpost straight section as per the coil winding and curing drawing and such that the gap between the wedges does not exceed .064.**

**NOTE 3**

**Wedge tips are positioned under Laminated Assembly End Spacers.**

3.3.7.2 Wind Turn #13 around lead end and along straight section to the non-lead end.

3.3.7.3 Install Wedge-Wedge Tip Assembly 2C, Insulated Wedge No. 2 and Wedge-Wedge Tip Assembly 2D in proper orientation starting at the non-lead end.

3.3.7.4 Install end spacer lamination at the non-lead end, centered on coil axis.

3.3.7.5 Wind Turn #13 around the non-lead end and along the straight section to the lead end.

3.3.7.6 Install End Spacer Lamination at the lead end, centered on coil axis.

3.3.8 Winding Of Turns #14 Thru #23

3.3.8.1 Wind Turn #14 around the lead end and along the straight section to the non-lead end.

3.3.8.2 Install Solid End Spacer #11 at the non-lead end.

3.3.8.3 Wind Turn #14 around the non-lead end and along the straight section to the lead end.

3.3.8.4 Install Solid End Spacer #10 at the lead end.

3.3.8.5 Wind Turns #15 thru #20, inserting End Spacer Laminations between individual turns at both ends (5 at LE, 6 at NLE).

3.3.8.6 Insert Solid End Spacer #12 at the lead end.

3.3.8.7 Wind Turn #21 around the lead end and along the straight section to the non-lead end.

3.3.8.8 Insert Solid End Spacer #13 at the non-lead end.

3.3.8.9 Wind Turn #21 around the non-lead end and along the straight section to the lead end.

3.3.8.10 Insert Solid End Spacer #14 at the lead end.

3.3.8.11 Wind Turn #22 around the lead end and along the straight section to the non-lead end.

3.3.8.12 Insert Solid End Spacer #15 at the non-lead end.

3.3.8.13 Wind Turn #22 around the non-lead end and along the straight section to the lead end.

3.3.8.14 Insert Solid End Spacer #16 at the lead end.

3.3.8.15 Wind Turn #23 around the lead end and along the straight section to the non-lead end.

3.3.8.16 Insert Solid End Spacer #17 at the non-lead end.

3.3.8.17 Wind Turn #23 around the non-lead end and along the straight section to the lead end.

3.3.9 Insert Wedge #3 And Wind Turn #24

3.3.9.1 Starting at the lead end of the coil, install Wedge-Wedge Tip Assembly 3A, insulated Wedges No. 3 and Wedge-Wedge Tip Assembly 3B. Install end spacer lamination at the lead end.

**NOTE 1**

**The wedges must be placed into the coil so that the markings are placed on the outer radius surface.**

**NOTE 2**

**Wedge-Wedge Tip interfaces are to be aligned relative to the centerpost straight section as per the coil winding and curing drawing and such that the gap between the wedges does not exceed .064.**

**NOTE 3**

**Wedge tips are positioned under Laminated Assembly End Spacers.**

3.3.9.2 Wind Turn #24 around the lead end and along the straight section to the non-lead end.

3.3.9.3 Install Wedge-Wedge Tip Assembly 3C, Insulated Wedges No. 3 and Wedge-Wedge Tip Assembly 3D in proper orientation starting at the non-lead end.

3.3.9.4 Install End Spacer Lamination at the non-lead end, centered on coil axis.

3.3.9.5 Wind Turn #24 around the non-lead end and along the straight section to the lead end.

3.3.9.6 Install End Spacer Lamination at the lead end, centered on coil axis.

3.3.10 Winding Of Turns #25 Thru #32

3.3.10.1 Wind Turns #25 thru #32, inserting End Spacer Laminations between individual turns at both ends (7 at LE, 8 at NLE).

3.3.10.2 Wind Turn #32 up to, but not around, lead end. The display panel will read: “Verify 32Turns”.

3.3.10.3 Count the number of turns: there should be a total of 32 turns in the coil. Verify that all parts have been installed correctly. Verify wedge gaps do not exceed .064”

3.3.10.4 Press “START” to continue.

3.3.11 Prep Coil For Cure

3.3.11.1 Apply a coat of Frekote 700 to the end of the cable. The coating should cover the cable from the end of the straight section to the end of the mandrel.

3.3.11.2 Clamp cable to the mandrel using a soft piece of rubber around the cable and a hose clamp, be sure not to damage cable.

**NOTE**

**The hose clamp will be removed prior to placing the coil in the formblock.**

3.3.11.3 Turn off Lump Detector.

3.3.11.4 Set cable tension to zero by turning the tension adjustment knob counter clockwise. Hold the cable so that there is some slack when the spindle brake engages.

3.3.11.5 Engage the main brake by placing the main brake in the engaged position.

3.3.11.6 Apply Kapton adhesive tape (1.00 in.-wide x .001 in.-thick with .0015 in. Adhesive - 12010181-20) where the cable is to be cut. Cut cable, leaving a 21 +2/-0 in. Lead from coil end saddle. Roll up lead and secure with tie-wraps.

3.3.11.7 End the winding program by pressing “START” on the remote control.

3.3.11.8 Break off Kapton spacer tabs – use extreme caution not to damage Kapton insulation.

3.3.12 Roll Mandrel

3.3.12.1 Place hand/auto switch on the Position Controller Panel in the “HAND” mode.

3.3.12.2 Release the main brake.

3.3.12.3 Retract the mandrel limit switch and rotate the mandrel until the centerpost is facing up.

3.3.12.4 Mount (8) bat wings (12010036-MCA) to centerpost using (16)1/4” T-Pins.

3.3.12.5 Pin the rollover arms to batwings.

3.3.12.6 Rotate the mandrel until the centerpost is facing down.

**CAUTION**

**Failure to properly secure bat wings #2 and #7 with anti-rotation blocks and pins could result in the mandrel falling off its supports.**

3.3.12.7 Attach anti-rotation blocks to bat wing #2 and #7. Insert alignment pins through roller stanchions and anti-rotation blocks to secure bat wings #2 and #7.

3.3.12.8 Remove pins from rollover arms. Remove strongback bolts and trunnion bolts.

3.3.12.9 Using overhead crane, remove winding machine strongback.

3.3.12.10 Install 3/8” shims down the entire length of spacer block.

3.3.12.11 Using overhead crane, lower and attach mandrel hoist to spacer block. Ensure that all bolts, pins and straps have been properly secured and remove anti-rotation blocks and pins from bat wing #2 and #7.

3.3.12.12 Remove lead and non-lead trunnions from Teflon wrapper.

3.3.12.13 Verify that the bat wing support plates (12010001-DOL2-7) are properly located and secured with (2) T-pins in each.

3.3.12.14 Using overhead crane, lower mandrel onto the Teflon wrapper positioning batwing #1 against #1 batwing support plate.

3.3.12.15 Remove hoist and strongback.

3.3.12.16 Remove hose clamps that were installed during winding and install fiberglass coated hose clamps at both ends using pusher blade spacer blocks.

3.3.12.17 Install pusher blades. Tighten screws to contact then back off 1/8 turn.

3.3.12.18 Place Velcro straps every 18 inches over the blade assembly and coil. Tighten straps to make a tight coil package.

3.3.12.19 Install rollover yokes starting in the center and working out to each end.

3.3.12.20 Attach trunnion at each end.

3.3.12.21 Loosen non-lead end trunnion locking screw.

3.3.12.22 Turn main power on.

3.3.12.23 Set motor speed control at 10.

3.3.12.24 Slide bat wing support plates clear of bat wings and yokes.

3.3.12.25 Press “RED” button on pendant and rotate assembly 180 degrees counter clockwise.

3.3.12.26 Remove bat wings (12010036-MCA) and cable clamps.

3.3.13 Prepare Ends

**NOTE**

**Perform each step of Section for both lead and non-lead ends.**

3.3.13.1 Attach end pusher spacers to each coil end saddle. Be sure correct end pusher spacers are used on each coil end saddle.

3.3.13.2 Install end saddle and position against outside coil turn. Be sure scratch protector does not become pinched between coil and end saddle.

3.3.13.3 Secure saddles to mandrel by applying Kapton adhesive tape (.625 in-wide x .0005 in.-thick with .0005 in. adhesive) over end pusher spacers.

3.3.14 Teflon Wrap Coil

3.3.14.1 Move carriage to lead end of mandrel.

**NOTE**

**Trim Teflon wrap around the centerpost keys using a razor.**

3.3.14.2 Using 0.002 in.-thick x 4 or 6 in.-wide Teflon film, wrap the coil using 44% to 48% (1/8" to 3/8" gap) overlap wrap. Remove clamp assemblies, Velcro straps, and cable guides just ahead of wrapping. After Teflon wrap is complete, reinstall Velcro straps and clamp assemblies. At lead and non-lead ends, secure Teflon with Kapton adhesive tape (.75 in.-wide x .0005 in.-thick with .0005 in. adhesive). Use heat gun as necessary to shrink Teflon onto coil.

**NOTE 1**

**Set clutch control tension to #40 (20 lbs)**

**NOTE 2**

**Be sure to tape on sides of blade assembly when securing Teflon wrap with Kapton adhesive tape.**

**NOTE 3**

**Clamp assemblies will remain on the coil ends until coil is transferred to the curing fixture.**

**NOTE 4**

**Roller yoke assemblies must be re-installed once wrap is past support location.**

3.3.14.3 Rotate mandrel so coil midplane is facing down.

3.3.14.4 Loosen centerpost mounting bolts only until torque is removed.

3.3.14.5 Mount (8) bat wings and position rollover support plates. Secure with T-pins.

3.3.14.6 Rotate coil/mandrel assembly with midplane facing up. Remove rollover yokes from blade spacer.

**CAUTION**

**Care shall be used to assure safe transfer of the coil/mandrel assembly to the curing fixture area. Failure to observe this caution can result in product damage.**

**WARNING**

**Hard hats are required when crane is in use. Failure to observe this caution may result in severe injury.**

3.3.14.7 Using overhead crane and strongback assembly, raise coil/mandrel assembly out of Teflon wrapper. Remove bat wings from the centerposts. Transfer coil/mandrel assembly to curing press area.

3.3.14.8 Care shall be exercised during lifting, moving, and transporting in- process and wound coils. Wound coils shall be suitably protected or packaged to minimize contamination.

4 Quality Assurance Provisions:

4.1 The Quality Assurance provisions of this procedure require that the technician shall be responsible for performing all assembly operations in compliance with the procedural instructions contained herein and the recording of the results on the production traveler.

4.2 The technician is responsible for notifying the technical supervisor and/or the cognizant engineer of any discrepancies occurring during the performance of this procedure. All discrepancies shall be identified and reported in accordance with RHIC- MAG-Q-1004.

4.3 Measuring and test equipment used for this procedure shall contain a valid calibration label in accordance with RHIC-MAG-Q-1000.

4.4 Calibration: Verify the calibration for the following equipment is current:

4.4.1 Cable Tensioner - Calibrate at the start of every production run and once a month thereafter.

4.4.2 Lump Detector - Set using a .015 inch feeler gauge before winding each coil.

4.4.3 Gaussmeter

5 Preparation for Delivery:

N/A

Figure 1
Cable History

When a coil is wound from a "Segment" it becomes a "Sub-Segment". See example below. Segment start position is 8,000 ft. and it's in an increasing direction, 8,000 being the start or (lead) and 10,000 the end or (Hub). Add "Sub-segment" length (1,833 ft.) to the lead or start position to determine your next "Start Position", which would be 9,833 ft.

CABLE HISTORY CABLE NO. BNL-0-0-00000 SEG-A

| Segment ID | Coil Wound/Sample | Segment Length | Segment Start Position | Date & Initial |
|---|---|---|---|---|
| A | Insulated Cable | | | 2/28/93 |
| A-1 | Test Coil | 1833 | 8000 | 3/10/93 |
| | | | 9833 | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

[X] Increasing [ ] Decreasing Segment Start Position

Spool
10,000 Ft. _____ 8,000 Ft.
Hub ↑ A-1 ↑

9833 8,000

Figure 2
Cable Routing Through Guide Rollers